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Cover

Future Fighter and Mother Plane—The tiny, radio-controlled research craft called HiMAT (highly maneuverable aircraft technology) hangs beneath the wing of a B-52 over the Dryden Flight Research Center in California. Beginning last summer, the remotely piloted research vehicle has been flown and tested to investigate advanced technology that could lead to greater maneuverability in future military aircraft. With lessons learned from HiMAT, U.S. fighters of the 1980s and 1990s may substantially out perform today's most modern attack aircraft, able to sustain twice the turn rate of present-day fighter planes at transonic and supersonic speeds.

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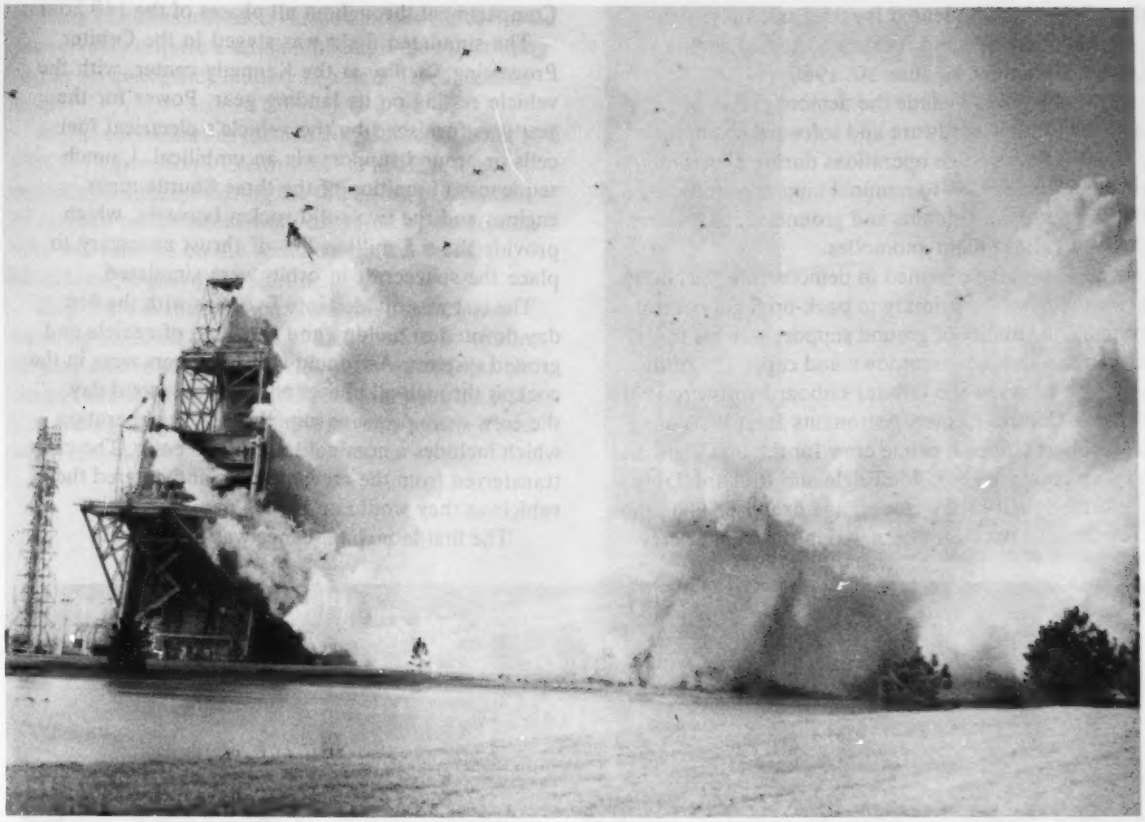


Storybook Success for Main Engine—After a disappointing performance in November blamed on a faulty welding wire, the Space Shuttle Main Propulsion Test Article scored an impressive runthrough in mid-December. NASA cameras at Bay St. Louis captured the blast from the 550-second test run.

Shuttle Test Engines Fired

A successful full-duration test of 550 seconds was conducted on the Space Shuttle Main Propulsion Test Article at NASA facilities at Bay St. Louis, Miss., on Dec. 17.

The three main engines were throttled from 100 percent rated power level to 90, 80 and finally, to 70 percent. Engine gimballing and pulsing were accomplished successfully.

One engine was cut off early, as planned, and the remaining two were run at 70 percent of rated power level for the last 5 seconds of testing.

No problems were encountered and test managers for NASA's Marshall Space Flight Center reported that all test goals were achieved. According to one NASA spokesman, the rockets roared back to life with "storybook" success.

Dress Rehearsal at the Cape

"Columbia", the first Space Shuttle Orbiter scheduled for flight in 1980, has undergone its first major simulated "flight" all systems test at the Kennedy Space Center in Florida. Astronauts and ground support teams put the vehicle through an around-the-clock critical operational runthrough following several days of delay and cancellations.

Among the tests performed during the 140-hour period were five separate launch and ascent flight profiles, on-orbit operations and one entry phase. Several hundred NASA and contractor aerospace engineers were on hand for the Orbiter Integrated Test, among them personnel from the Kennedy Launch Center, the Johnson Space Center, Houston, and Rockwell International Space Division, Downey, Calif.

The Orbiter Inegrated Test is one of the final verifications of Orbiter systems and electronics before

the "Columbia" is cleared for final assembly with external tank and solid rocket boosters. The first launch is planned for June 30, 1980.

Test objectives include the demonstration of selected Orbiter hardware and software (computer programs) subsystem operations during a mission timeline. In addition to nominal launch conditions, the test put the astronauts and ground support teams through various flight anomolies.

The test is also designed to demonstrate the ability to switch from the primary to back-up flight control systems, the ability of ground support systems to support an Orbiter countdown and capability of the interface between the Orbiter onboard software to the Mission Control Center. Astronauts John W. Young and Robert Crippen, prime crew for the first flight and backup crew members Joe Engle and Richard Truly performed their future roles in the exercise. The prime crew and the backups alternated in the Orbiter crew Compartment throughout all phases of the 140 hours.

The simulated flight was staged in the Orbiter Processing Facility at the Kennedy center, with the vehicle resting on its landing gear. Power for the test was furnished by the vehicle's electrical fuel cells or ground support via an umbilical. Launch sequences of ignition of the three Shuttle main engines and the two solid rocket boosters, which provide the 6.5 million lbs. of thrust necessary to place the spacecraft in orbit, were simulated.

The test was divided into five runs with the first day devoted to buildup and checkout of vehicle and ground systems. Astronaut crew members were in the cockpit through all phases and on the second day the crew wore pressure suits through the operation which includes a nominal launch and entry. The crew transferred from the crew quarters and entered the vehicle as they would on launch day.

The first launch sequence was normal, but

Simulation for the Senior Astronaut—During December's successful simulated flight of the Space Shuttle Orbiter, John W. Young was at the controls as commander of the primary crew. Young, a retired Navy Captain, has been flying space missions since 1965. A veteran of the Gemini program, he flew on the first manned mission, Gemini 3, and commanded Gemini 10. Young circled the Moon with Apollo 10 and landed there as commander of Apollo 16. He is chief of the Astronaut office at the Johnson Space Center. The first actual Shuttle mission, and the era of space transportation, begins under his sure hand.

ensuing launches included various modes which would conceivably require a mission abort, return to landing site or an emergency landing at a designated landing strip.

Flight controllers at the Mission Control Center's (MCC) Operation's Control Room at Houston, monitored displays during the tests. Key parameters of systems performance were observed by controllers who will later be on the scene during the actual launch and flight of the Shuttle.

Engineers in the Mission Evaluation Room in a building adjacent to the MCC also monitored similar display and voice loops. Their concentration was on data of selective portions and procedures of the test. It is their job to develop solutions to problems if and when they occur.

Candidates For Astronaut

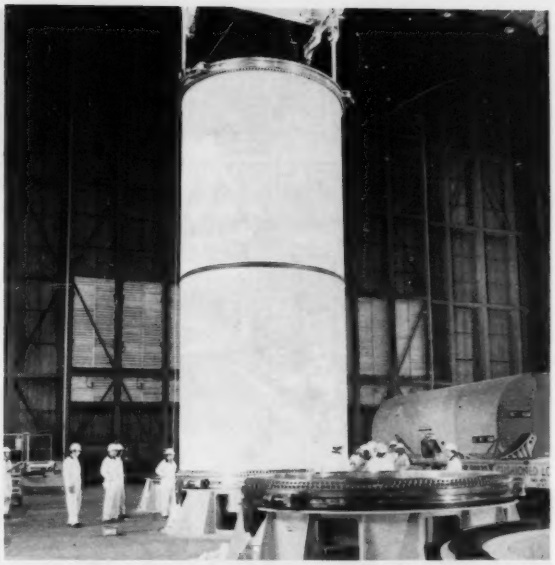
A total of 2,937 men and women applied for 10 to 20 open astronaut positions during a NASA two-month recruiting drive that ended Dec. 1. More than 300 of the hopefuls applied for both mission specialist and pilot categories. Future Space Shuttle missions will employ astronauts in both categories.

The number of women applicants for the two categories totals 390. The astronaut selection board at the NASA Johnson Space Center, Houston, will narrow the selection to those best qualified in the two categories. Approximately 100 will be selected for preliminary screening and physicals at the center next spring.

Those selected as astronaut candidates will report to Johnson in July 1980 for their one-year training and evaluation period. Final selection as an astronaut will depend on satisfactory completion of the evaluation period.

Pay for civilian candidates will be based on the federal government's General Schedule for grades GS-11 through GS-14, with approximate salaries from $20,611 to $34,714 per year. Military candidates will be assigned to Johnson but will remain on active military status for pay, benefits, leave and other military matters.

NASA plans to accept applications for Space Shuttle astronauts on an annual basis. The number of open positions will depend on NASA's need for pilots and mission specialists.



SRBs Coming Together—A forward center segment of the first Solid Rocket Booster destined to launch the Space Shuttle is off-loaded in the Kennedy center's Vehicle Assembly Building. Other SRB components, such as the aft skirt and aft motor segments, are already in place on the mobile launch platform. The positioning processes is called "stacking" and rollout of the complete Shuttle stack—orbiter, SRBs and external tank—is targeted for mid-April 1980.

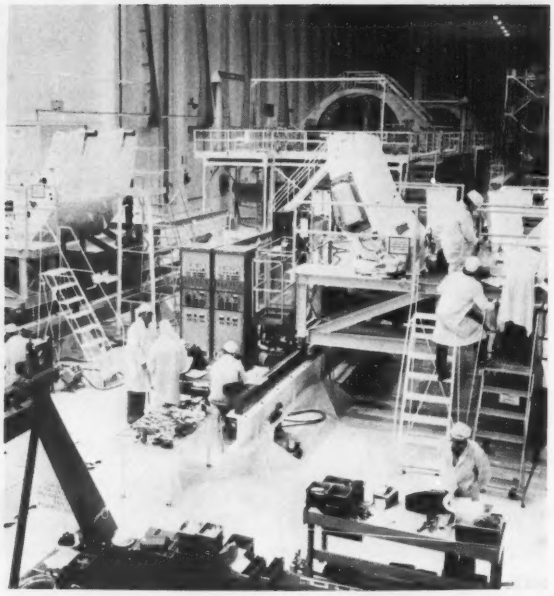
Life Science Investigations Chosen

NASA has selected 78 life science areas of investigation—74 proposals from the United States and four from three foreign nations—for two life science Spacelab/Space Shuttle flights planned between 1983 and 1985. Specific investigations will be selected for each mission about two years prior to flight.

The 78 were chosen from about 370 proposed experiments.

The selected investigations include the following:

- Behavior and Performance
- Bioengineering/Technology
- Plant Physiology
- Cellular Biology, Biophysics, Biochemistry, Immunology, Virology and Microbiology
- Developmental Biology, Embryology and Gerontology
- Endocrinology, Metabolism and Nutrition
- Musculo-skeletal and Physiology
- General Physiology and Pharmacology
- Renal, Fluid and Electrolyte Physiology
- Hematology



Preparing ESA's Pallets—Technicians in white perform checkout operations on two experiment pallets in the Operations and Checkout Building High Bay area at the Kennedy Space Center. The pallets were built by the European Space Agency for their Spacelab Project.

Slated for OFT 4—Equipment assemblies are installed on one of the European Space Agency's pallets, this one due for use on Orbital Flight Test 4. The ESA devices, with various experiments mounted on their housings, will be carried in the cargo bay of the Space Shuttle.

- Cardiopulmonary and Stress Physiology
- Cardiovascular Physiology and Clinical Medicine
- Vestibular System and Neurophysiology

The 78 principal investigators are from U.S. and foreign universities, private and government organizations and the NASA scientific staff. Foreign countries involved are Australia, Switzerland and the United Kingdom. Each country is responsible for funding its own investigators.

Spacelab is a pressurized Space Shuttle system element designed to be operated by a payload specialist team of up to four persons. It is estimated that 15 to 20 investigations can be accommodated in each life science Spacelab mission. The two missions are planned with an 18-month launch interval, with the first launch scheduled for mid-1983. A few additional life science investigations are expected to go on other Shuttle missions during the same time period. The life science investigations must comply with flight safety requirements and engineering and management practices specified in NASA guidelines.

Spacelab, funded and built by the European Space Agency, will be carried to and from orbit by the Space Shuttle and remain attached to the orbiter throughout each flight. Spacelab will serve as a laboratory for life science and other investigations in near-Earth orbit for a period of one week to 10 days.

With the advent of the Space Shuttle and availability of standard, space-qualified hardware which can be placed in orbit, repaired, retrieved or replaced, NASA plans to use this capability to reduce payload costs, while making space flight more accessible to a wider range of users.

Tracking and Data Acquisition Changes

NASA plans to change its space tracking and data acquisition activities when the Space Shuttle and the Tracking and Data Relay Satellite System become operational in the 1980s. The plans are a result of a review of responsibilities at NASA's Goddard Space Flight Center, Greenbelt, Md., for tracking and data systems activities. The changes are intended to insure that tracking stations and network operations will be managed most efficiently and effectively using both government and contractor personnel and resources.

The Tracking and Data Relay Satellite System in 1982 will take over all of the tracking and data acquisition support of low Earth-orbiting spacecraft. At that time, the Spaceflight Tracking and Data

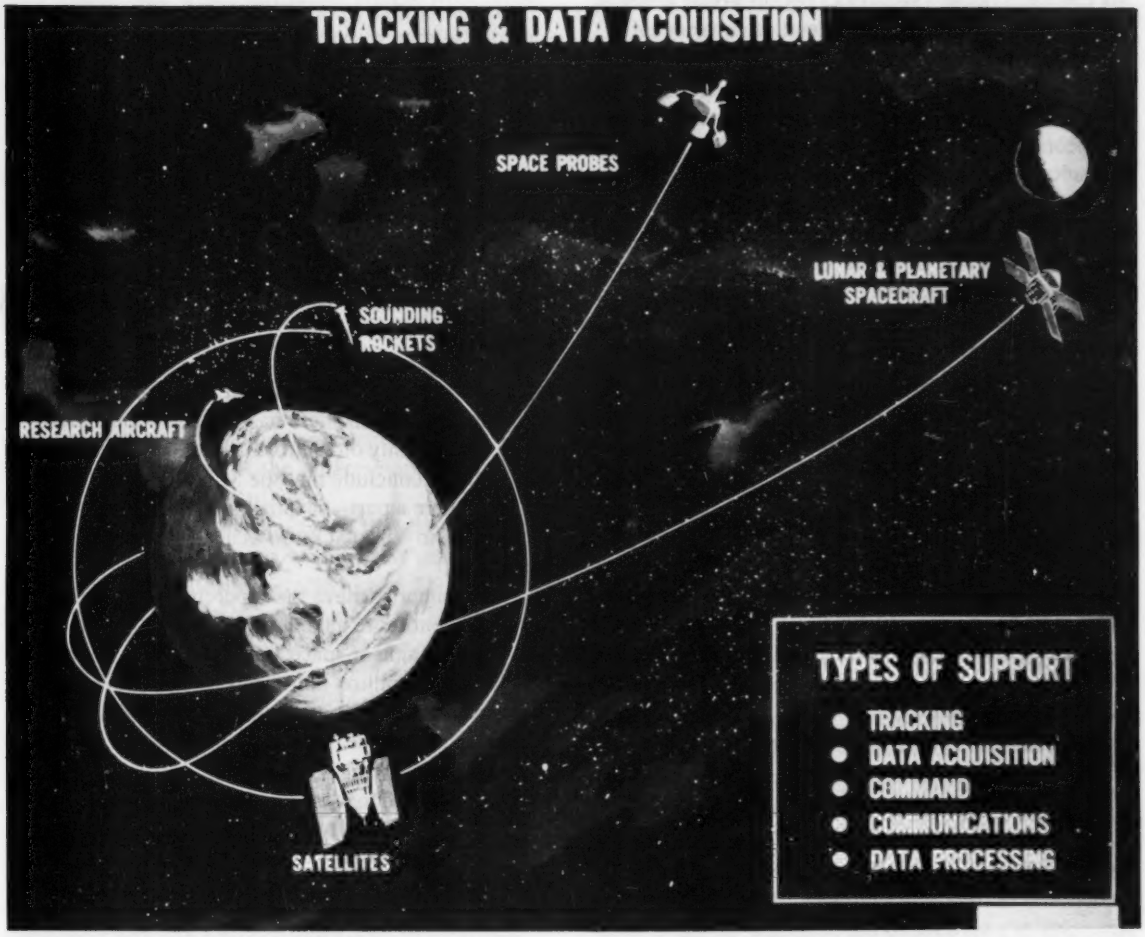
Network, NASA's worldwide network of tracking stations, will be closed, with the following exceptions:

- The Alaska station will be retained until Landsat 3 becomes inoperative, anticipated in 1984.
- The Goddard station will be retained until the International Ultraviolet Explorer spacecraft becomes inoperative, anticipated in the mid-1980s.
- The Merritt Island, Fla., and Bermuda stations will be converted to launch support and range safety facilities.
- The Goldstone, Calif., Australian and Spanish stations will be retained for support of geosynchronous and highly elliptical orbit spacecraft.

The Rosman, N.C., facility expects to cease operations in January 1981. The facility had been supporting the Applications Technology Satellite 6, which is no longer operating, and the Orbiting Astronomical Observatory, which will complete its mission in November 1980. The Rosman station is operated for NASA by the Bendix Field Engineering Corp., which employs about 120 people at the site.

The stations to be closed in 1982 include Hawaii; Guam; Quito, Ecuador; and Santiago, Chile. The station in Winkfield, England, will be closed in 1980.

The Spaceflight Tracking and Data Network capabilities of the Goldstone, Australian and Spanish stations are similar to those required for the Deep Space Network stations at the same locations. Combining the capabilities at each station will achieve more efficient use of the facilities, and save money.



Due for Change—The decade of the 1980s will see this basic system revised with the advent of the Space Shuttle and the Tracking and Data Relay Satellite System. At present, the program's prime responsibility is to provide tracking, data acquisition and processing, command and communications support to meet the requirements of all NASA flight projects. The new system will reduce and combine some facilities and will rely on both government and contractor support.

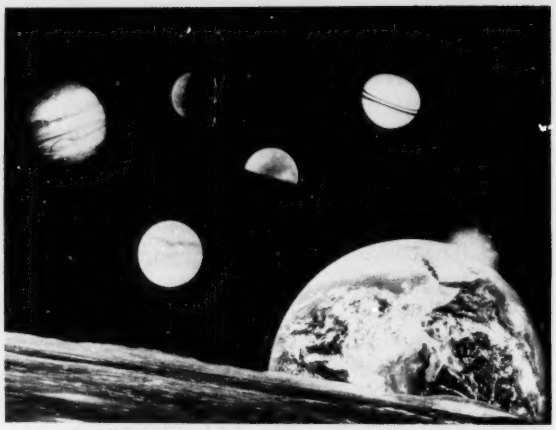
The facilities at Goldstone, Australia and Spain will be consolidated into a network under management of NASA's Jet Propulsion Laboratory, Pasadena, Calif., in 1983–1985.

Ten years ago there were approximately 1,200 Civil Service employees in the development, implementation and operation of tracking and data systems at Goddard for support of both manned and unmanned spacecraft. Since then, many of the functions have become routine contractor operations so that today, approximately 650 Civil Service people are assigned to tracking and data systems work, including the management and coordination of some 30 operations contracts.

The Goddard review has shown that consolidation and restructuring of the contracts into approximately six contracts in the 1982–1983 period would result in a more effective and efficient blend of government and industry performance.

The government work will focus on mission planning, technology development and systems engineering. Contractors will be responsible for operational tasks. As a result, the Civil Service complement devoted to tracking and data systems at Goddard will be reduced between 1980 and 1986 by about 225, at a rate of about 35 to 40 each year. At the same time, Civil Service personnel requirements in other Goddard programs are expected to increase at about the same rate and the displaced tracking and data employees can move into the new positions.

About 5,300 contractor personnel are employed in Goddard tracking and data system work around the world. The effect of these actions will be to reduce this number over the next five years by about 2,300, including 900 in the Washington-Baltimore area and 1,400, 500 of whom are foreign nationals, at Space Tracking and Data Network facilities around the world.



Synthesis of the Solar System—From NASA spacecraft, these images of six of the planets in the solar system and the Earth's moon were taken. Individual pictures were pieced together to show a complete area. The picture mosaic consists of: foreground—the Earth rise over the lunar surface with the sun flare on the edge of the Earth's limb. First planet shown above the Moon is Venus; top left to right are the planets Jupiter, Mercury, Mars and Saturn.

Huge Cluster of Galaxies Suggested

Using data obtained from high-flying NASA aircraft, scientists believe they may have discovered the largest cluster of galaxies—groups of hundreds of millions of stars—ever known. And if the indirect evidence is correct, the existence of the suspected supercluster goes back to the beginning of the universe.

This evidence for the supercluster comes from analysis of measurements from NASA U-2 aircraft of the cosmic microwave background radiation left over from the Big Bang*.

In 1978, a NASA-University of California at Berkeley team used the instrumented aircraft operated by NASA's Ames Research Center, Mountain View, Calif., to survey remnants of such radiation in the entire Northern Hemisphere sky. A similar survey of the Southern Hemisphere has just been completed.

The University of California scientists used this U-2 data to conclude that the Milky Way Galaxy—of which we are a part—is hurtling toward the constellation Virgo at more than a million miles an hour.

Astronomers believe the supercluster contains 30 to 40 percent more galaxies than normally found in the same volume of space, and that it may stretch across some 2 billion light years of space. When compared to the 10 billion-light-year-diameter of the observable universe, the supercluster would encompass 1 percent of the volume of it.

Dr. George Smoot of the University of California noted that not enough time has passed since the Big Bang for such a supercluster to have formed. This means that such a gigantic concentration of mass could go back to the beginning of the universe.

The surveys by NASA aircraft suggest that the

* The primordial explosion which many scientists believe began our universe.

event which started the universe about 15 billion years ago was extremely regular; that is, a powerful but tightly controlled expansion with matter moving outward in all directions at an equal rate.

Now comes the possibility of the supercluster and, "if we have one such huge concentration of matter," says Smoot, "there are probably others." This implies that at the time of its formation, the universe was "lumpy"—that the primordial fireball itself was lumpy instead of being extremely smooth as measurements by the same researchers and others such as Rainer Weiss of the Massachusetts Institute of Technology and David Wilkinson of Princeton University had previously suggested.

The work of other astronomers has contributed to the suspicion of "something unusual in this part of the sky," Smoot said. X-ray astronomy studies by A. C. Fabian, Cambridge University, and R. S. Warwick, University of Leicester, have found indications of a large-scale structure in the direction of Virgo. J. A. Tyson and J. F. Jarvis of Bell Laboratories have made automated counts of faint galaxies on long-exposure photographic plates and have found evidence of a northern supercluster of galaxies—far more than in any other part of the sky surveyed.

Scientists are surprised at the evidence for a cluster billions of light years in diameter. Said Smoot: "It boggles the mind that such a structure could exist—a big fraction of the observable universe." Apparently there is only one such collection of mass relatively close to us. Others, however, may be found at great distances. Despite the possible existence of the supercluster, the mass of the universe appears, on the average, to be evenly distributed.

Smoot is somewhat disappointed that the finding could disrupt the pattern of a completely uniform Big Bang because a uniform universe history fits very well with recent work on subatomic particles. "It is a paradox," he said, "that the universe is so uniform, but yet it appears to contain non-uniform structures on very close to the largest possible scale."

Proposals for Sun-Earth Probes

Scientists are being approached to propose experiments for a program of coordinated satellite measurements designed to provide a better understanding of the near-Earth space environment and Sun-Earth relationships. The program, called Origins of Plasmas in the Earth's Neighborhood, would attempt for the first time to examine the collective behavior of specific components which make up the geospace system—the near-Earth interplanetary medium, magnetosphere, ionosphere and upper atmosphere.

An understanding of this system is a prerequisite to understanding Sun-Earth relationships and their effect on our planet's environment, including short- and long-term weather and climate prediction and the impact of solar phenomena on communications. Current understanding, gained from previous satellite programs, clearly shows a high degree of interaction between all geospace components.

Basically, the program's aim is to investigate the flow of mass, momentum and energy through the solar wind and electrified environment near Earth, using instrumentation for remote sensing and closeup measurements of electromagnetic radiation, fields, particles and plasmas (electrified matter).

The program calls for simultaneous observations from a minimum of four spacecraft, placed in specific key regions of space and operating in widely different orbits. The satellites, launched by the Space Shuttle over a one-year period in the mid-1980s, would be placed to observe each of the major geospace plasma source regions (solar wind, ionosphere) and storage regions (ring current, plasma sheet, distant geomagnetic tail).

Each spacecraft would have significant orbit-change capability to provide observational flexibility and permit exploration of a vast volume of geospace. The spacecraft would operate for at least four years.

Although the program has not been authorized by Congress, scientists are being asked to submit their proposals by March 15, 1980, in order to ensure maximum scientific participation in the program and design of the spacecraft.

Objectives of the proposed mission would be to:

- Understand the physical process controlling the origins, entry, transport, storage, acceleration and loss of electrified matter, and electrical current in the Earth's neighborhood.
- Understand cause-and-effect relationships among the closely coupled solar wind, magnetosphere (the magnetic envelope that surrounds Earth) and the ionosphere (the electrified part of the atmosphere).
- Trace the flow of matter and energy through the geospace system from their interplanetary or atmospheric origins to ultimate deposition into the atmosphere or loss to the interplanetary medium.
- Assess the importance to Earth's environment of variations in energy deposition into the atmosphere caused by plasma processes.

• Utilize the unique capabilities of the program for solar wind and other studies.

This will be the first program to address the geospace environment as a whole. Past observations have been obtained primarily by single-point satellite measurements, and more recently by multi-point satellite measurements designed to study the linkage between no more than two geospace components.

Program management will be the responsibility of the Solar Terrestrial Division of NASA's Office of Space Science, Washington, D.C. Project management is expected to be assigned to NASA's Goddard Space Flight Center, Greenbelt, Md.

First Flight for Pivot-Wing Aircraft

First flight of the manned NASA Oblique Wing Research Aircraft took place on Dec. 21 at NASA's Dryden Flight Research Center, Edwards, Calif. Called the AD-1 for NASA Ames-Dryden, the research aircraft employs a pivoting-wing concept which could reduce noise and lower fuel consumption of future high-speed, transport-type aircraft.

Analytical and wind tunnel studies conducted by Ames Research Center, indicate that future oblique wing transport aircraft flying at 1,600 kilometer per hour might achieve twice the fuel economy of more conventional swept-wing transport aircraft.

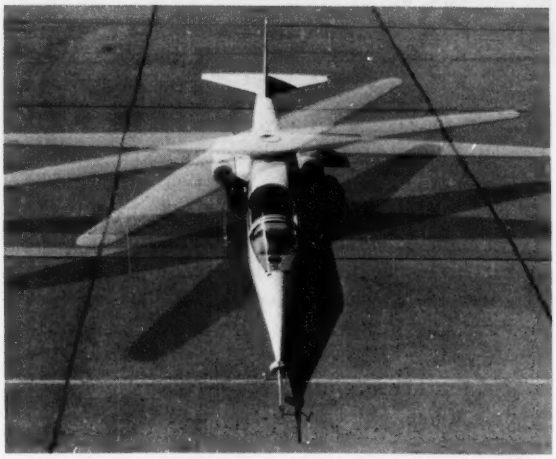
At lower flight speeds, the wing would be oriented at right angles to the fuselage, providing efficient, quiet operation for takeoff and landing as well as for low-speed cruise flight. The concept offers good low-speed stability and control characteristics and does not require complex high-lift systems. The engine thrust required for take off would be substantially reduced and could result in quieter operations in the terminal area.

For high-speed flights, the wing would be pivoted fore and aft to form oblique angles up to 60 degrees with the aircraft's fuselage. Studies indicate that this "scissor-wing" concept would permit better high-speed flight performance. As the aircraft flies faster, pivoting the wing to an oblique angle would decrease air drag, permitting increased speed and longer range for the same fuel expenditure.

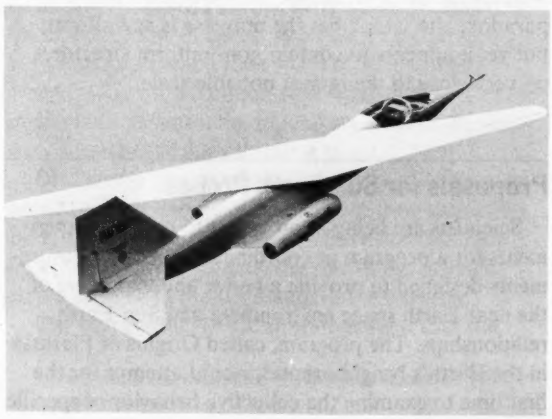
Because the concept is a significant departure from conventional aircraft design, NASA has initiated a low-cost exploratory program to study the fundamental low-speed operations of such an aircraft using this small, lightweight, manned test aircraft. Tom McMurtry, pilot, was at the controls for the first flight.

The research aircraft is approximately 12.2 meters long, with a wingspan of 9.7 m. Powered by two small 99.8 kilogram thrust turbojet engines, the AD-1 has a gross weight of approximately 907 kg and will be capable of speeds in the 241–354 km/hr range.

For the first flight, the wing remained perpendicular to the aircraft fuselage. On later flights, the wing can be pivoted from zero to 60 degrees while in flight. The aircraft was built by the Ames Industrial Co., Bohemia, N.Y., under a $240,000 fixed-price contract with NASA Dryden.



Attitudes of the Oblique Wing—The AD-1 research aircraft flew at the Dryden center in mid-December, initiating low and high speed testing of its pivoting oblique wing. In the top picture, a triple exposure shows three different wing positions of the small aircraft—0, 30 and 60 degrees of wing swing. At lower flight speeds, the wing is oriented perpendicular to the fuselage, providing efficient, quiet operation for takeoff and landing. The wing is pivoted fore and aft in high speed flight to form oblique angles up to 60 degrees with the aircraft fuselage, permitting increased speed and longer range for the same fuel expenditure.



Young Named Goddard Center Director

A. Thomas Young has been named director of the NASA Goddard Space Flight Center succeeding Dr. Robert S. Cooper who left government service in June. Young, deputy director of the NASA Ames Research Center, has been with the agency since 1961, when he joined the NASA Langley Research Center. While at Langley, he was mission director for the Viking exploration of Mars and was mission definition manager of the Lunar Orbiter Project.

Young served as director of the planetary program in the Office of Space Science at NASA Headquarters in Washington from November 1976 to February 1979, when he was named deputy director of Ames. He received NASA's highest award, the Distinguished Service Medal, in 1977 and is a member of the American Institute of Aeronautics and Astronautics and a fellow of the American Astronomical Society.

Young, born in Nassawadox, Va., earned bachelor's degrees in aeronautical engineering and mechanical engineering from the University of Virginia in 1961. He was a Sloan Fellow at the Massachusetts Institute of Technology in 1971–72 and received a master's degree in management.

Study of Unique Power Plant

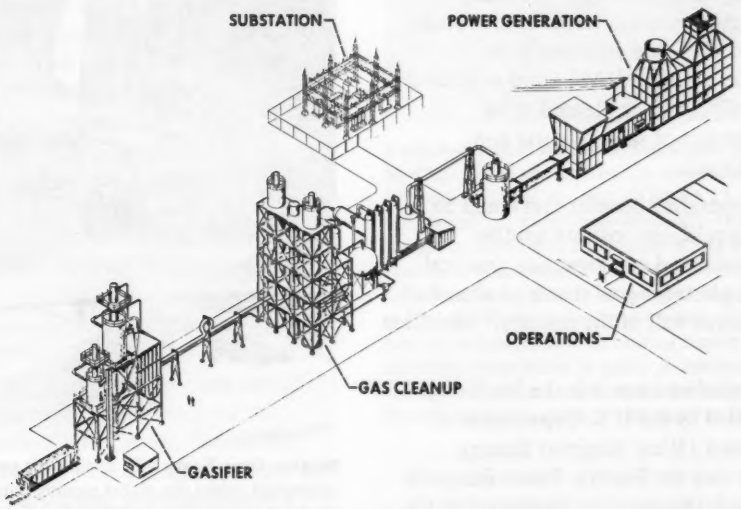
Lewis Research Center and The Cleveland Electric Illuminating Company have agreed to cooperate in a feasibility study that has broad implications for both the electric power and high sulfur coal industries.

If results of the study confirm expectations, a unique plant could be built at Lewis to generate heating and process steam and simultaneously produce electricity. The plant would represent an attractive option for the highly efficient use of high sulfur coal with minimal environmental impact. The plant could be the first in the world to combine coal gasification, integrated combined-cycle power generation and generation of steam.

Announcement of the study was made jointly by Dr. John F. McCarthy, Jr., Lewis Director, and Robert M. Ginn, President of The Illuminating Company. By controlling the air or oxygen flow and temperature, the plant would convert high sulfur coal into a clean fuel gas. Pollutants in the gas would be removed by one of a number of processes already commercially available. The clean gas would be burned to drive a gas turbogenerator to produce electric power. Waste heat from the gas turbine would be recovered and used to produce steam, which would be used for heating or for additional electric power generation in a steam turbogenerator.

During those periods when the waste heat can be used fully, the plant could approximately double the

GASIFIER ALTERNATIVE POWER PLANT CONCEPT



Artist's concept of coal gasification plant for the Lewis center

amount of energy extracted from each ton of coal compared with conventional methods of electric power generation alone.

The feasibility study will be conducted under contract by the Cleveland-based international engineering firm of Davy McKee Corporation. If the six-month, $200,000 study confirms expectations, and assuming funding availability, design of the facility could begin in 1981. The concept of the plant is such that startup of the operating phase could then be achieved in 1984.

"We envision the plant as a fully working facility, not simply a demonstration plant to prove new technology," Dr. McCarthy explained. "In operation, it would supply our baseload electrical needs at Lewis plus steam for heating and process requirements. At the same time, we intend that the plant would demonstrate operating techniques and provide results that can be broadly applied throughout the electric power industry and other industries for heat energy or power needs."

"The potential operating benefits of such a plant on a commercial scale would be to assist in keeping costs to industry and the consumer at the lowest possible levels consistent with our national need to improve our environment and reduce our dependence on imported energy," Dr. McCarthy added.

CEI's electric utility specialists will provide guidance on technical and economic aspects and overall evaluation of the feasibility study. "Our team will be working with their Lewis counterparts on matters such as long-term reliability, operating practices, CEI's requirements in terms of the future interests of its customers, and relations with government agencies involved," Mr. Ginn explained. "The Illuminating Company is pleased to be associated with a project of such promise and potential," he continued.

"In addition to operating benefits that could be derived, the plant would demonstrate another environmentally sound and economically practical way to utilize the high sulfur coal that is so abundant in Ohio and the eastern half of the country," Mr. Ginn added.

Additional technical assistance in the feasibility study will be provided by the U.S. Department of Energy's Morgantown (West Virginia) Energy Technology Center and the Electric Power Research Institute, the research organization sponsored by the nation's electric utilities.

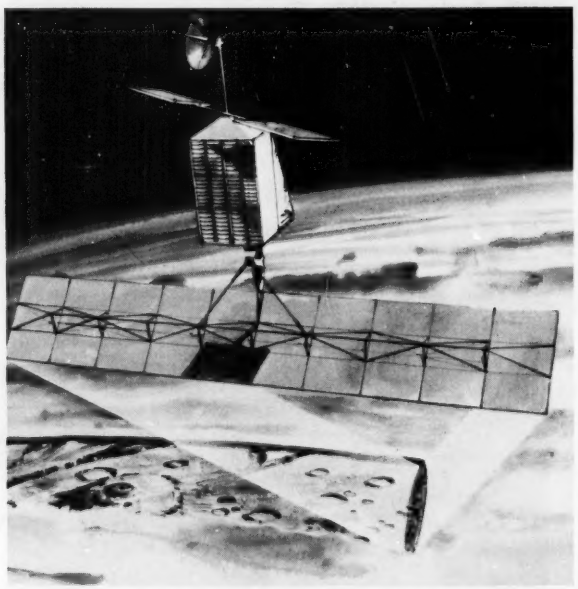
Radar Mapping of Venus

The Jet Propulsion Laboratory in Pasadena has selected Martin Marietta Aerospace, Denver Division in Colorado, and the Space and Communications Group, Hughes Aircraft Co., El Segundo, Calif., to conduct studies which could lead to development of an unmanned NASA spacecraft to make topographical radar maps of Venus in the mid-1980s.

When the $500,000 study contracts are completed next summer, one of the two companies may be chosen to develop the Venus Orbiting Imaging Radar (VOIR) spacecraft if the mission is approved by Congress.

Planned for a Space Shuttle launching and five-month trip to Venus, the spacecraft would first be placed in a 300 by 19,000-kilometer Venutian orbit for a two-month gravity study of the planet.

The craft's orbit would then be circularized at 300 km for a 120-day radar mapping sequence, which would cover nearly all the surface of Venus at low resolution 1.0 km and about 2.5 percent at high resolution, 100 meters. The primary mapping instrument aboard the spacecraft will be a side-looking synthetic aperture radar similar to one flown in 1978 aboard NASA's experimental oceanographic satellite, Seasat.



Soaring Over Venus—In this artist's conception, the VOIR spacecraft orbits the planet gaining data for a topographic study of the surface. Venus is the closest neighbor of Earth inbound toward the Sun.

Marshall Man Wins Excalibur

Frank J. Nola of the Marshall Space Flight Center was chosen as one of the first recipients of the Excalibur Award, a new citation created to honor civilian and military personnel of the Federal Government for their contributions. Nola was chosen by a select committee of seven persons from outside the executive branch of government, a group formed by Rep. Michael D. Barnes, D-Md. Presentation of the award to the NASA official was made at the U.S. Capitol and the Excalibur Award certificate was signed by the Speaker of the House, Rep. Thomas P. "Tip" O'Neill. Nola was cited for his design of the Power Factor Controller, a simple and inexpensive device expected to produce substantial savings of energy in the operation of electric motors.

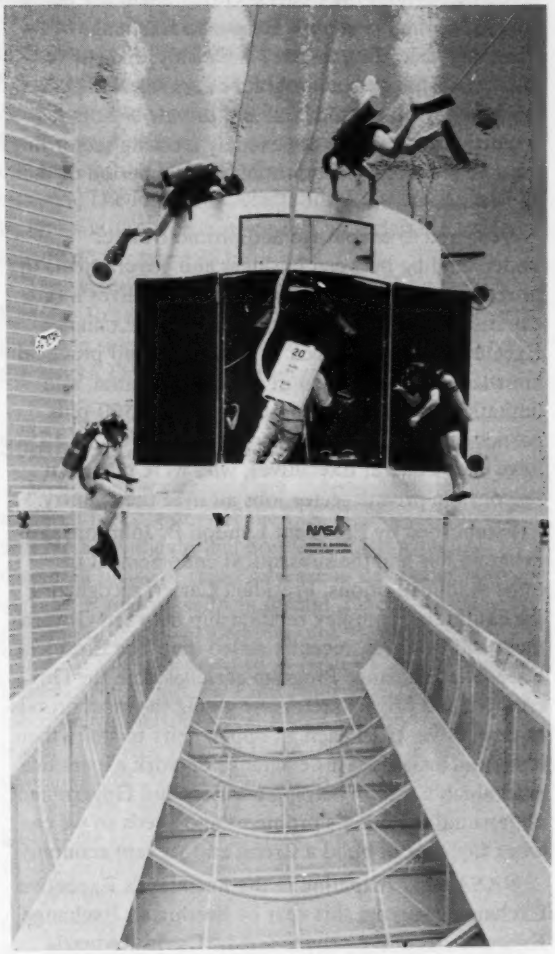
Solar Electric Propulsion System

Two companies have been selected to receive parallel contracts for design definition studies of a new Solar Electric Propulsion System that would become an integral part of the NASA Space Transportation System. Contracts, valued at $1.15 million each, will be awarded to Boeing Aerospace Co., Seattle, Wash., and Lockheed Missiles and Space Co., Sunnyvale, Calif. The work will be performed over the next 12 months.

Solar electric propulsion technology has been under development by government and industry since the early 1960s. Its very efficient propellant usage, long continuous operating lifetime, and use of solar energy to provide electric power, make it especially suitable for rendezvous with comets and asteroids, delivery of probes to planets in the outer solar system, close observation of the Sun and extended duration operations in Earth orbit. The Solar Electric Propulsion System is a candidate for use on a number of upcoming U.S. planetary and Earth-orbital investigation.

Responsibility for definition and development of the new propulsion system has been assigned to NASA's Marshall Space Flight Center, Huntsville, Ala. Completion of these system definition studies will provide the basis for subsequent development of a flight system.

Other companies competing for the studies were Hughes Aircraft Co., El Segundo, Calif., and Rockwell International, Downey, Calif.



Underwater Drill for Space Telescope—Astronaut Bruce McCandless, in pressure suit, is shown working with a full-scale mockup of a part of NASA's Space Telescope, submerged in a huge water-filled tank called the Neutral Buoyancy Simulator. Four scuba divers stand by during the exercise at the Marshall Flight Center. The unmanned Space Telescope is designed to be serviced in orbit and Marshall engineers use the water environment of simulated weightlessness to train astronauts in making repairs and changing telescope components in space. A mockup of the Space Shuttle Orbiter cargo bay lies below the work site. Proposed launch for the Space Telescope is sometime in 1984.

Federal Executives Sought for Presidential Exchange

High-calibre executives at the GS-13, 14, and 15 levels throughout the Federal Government are being sought for the President's Executive Exchange Program, according to Lee M. Cassidy, Executive Director. This unique program offers selected skilled executives from the Federal and private sectors the opportunity to gain experience by crossing sector lines for a year during the important middle period of their careers.

Designed to encourage and promote better understanding between business and government, the program provides the participating executives a rare experience in professional growth. Each Exchange Executive has the chance to gain first-hand practical knowledge of the procedures, goals, potential, and limitations of the opposite sector. Of the 500-plus participants since the first program in 1970–71, 175 have been Federal Executives, who were placed in responsible private sector jobs all over the country.

Established by President Lyndon B. Johnson, the Program has had the subsequent endorsement of three Administrations. President Carter, recognizing the continuing complex relationship between Government and business, recently stated that "the President's Executive Exchange Program enriches both the Government and private sectors by giving the most promising executives from each an opportunity to share their ideas and insights. This exchange of work experience is a valuable tool in helping business and Government understand the other's problems and needs so we can work together to build a strong and vibrant economy."

NASA is participating in the President's Executive Exchange Program this year by hosting an Exchange Executive from the private sector. David Reduzzi, who has been a Marketing Specialist for the Ford Motor Company, is the Special Assistant to the Director for Energy Systems at NASA for the Exchange year.

To assure the continued high quality of the participants, an evaluation is made of leadership qualities, initiative and management ability, and the potential for the Senior Executive Service. Prior to final approval by the agency or department head, nominees must be screened by their personnel officer and Executive Resource Board.

Nominations for the coming Exchange year beginning September 1980 are due not later than April 15, 1980. Potential candidates should direct their inquiries to either the personnel directors of their Federal agency or department, or to the President's Commission on Executive Exchange, P.O. Box 14179, Washington, D.C. 20044, (202) 632–6834.

"Right Stuff" Reassembled—An upcoming television special on the X-15, the research aircraft that took America to the edge of space, brings together its former pilots at Dryden Flight Research Center. From the left are A. Scott Crossfield, first to fly the X-15, Adm. Forrest "Pete" Peterson, now chief of Naval Air Systems Command, Col. Joe Engle, now backup Astronaut for the Space Shuttle, and Harrison Storms, formerly of North American Aviation. Other Dryden pilots interviewed were Fitzhugh Fulton, William Dana and Milton O. Thompson.

Investigators Selected for Climate Studies

NASA planners have selected 33 scientific investigations for four satellite missions during 1982 through 1985. The investigations, 23 from the United States and 10 from six foreign nations, will be concerned with climate and upper atmospheric research.

The 23 U.S. investigations have been selected from 11 universities, one private organization and two government agencies. The foreign countries involved are: Canada, Japan, France, United Kingdom, Federal Republic of Germany and Italy.

Along with the 33 principal investigators, more than 80 co-investigators are associated with the selected investigations. More than 80 responses were received by NASA from the world's scientific community in reply to an announcement last January.

Langley Scientist Honored—Dr. Richard T. Whitcomb of the Subsonic-Transonic Aerodynamics Division, Langley Research Center, has received the Howard N. Potts Medal for contributions in applied science, presented by the Franklin Institute in Philadelphia. Dr. Whitcomb, shown inspecting a supersonic plane model, was recognized for his work in the development and application of the area rule concept, the supercritical wing and winglet.

The 33 principal investigators will be organized into three teams and will initially participate with NASA through scientific studies and investigations in support of the development of three experiment instruments. Each country will be responsible for funding its own investigations and its participation in support of instrument development. Costs of the U.S. investigations are expected to total about $55 million over the next five years, including NASA-developed instruments.

The Earth Radiation Budget Experiment and the Stratospheric Aerosol and Gas Experiment II will investigate the spatial and temporal variations of the radiation budget and stratospheric aerosols respectively. The Stratospheric Aerosol and Gas Experiment II and Halogen Occultation Experiments will each investigate ozone variability and the latter will focus on the effect of halogens on ozone along with other upper atmospheric constituents and physical processes.

All three experiments will be flown on the Earth Radiation Budget Satellite. The satellite will be carried to a medium inclination orbit by the Space Shuttle and released as a free-flyer for its two-year scientific mission.

After instrument development, the investigators will plan for orbital operations, data processing, investigating instrument performance, verifying the adequacy of data products and completion of individual initial scientific data use investigations. Additional data use investigations may be sought through a subsequent announcement of opportunity.

Identical Earth Radiation Budget Experiment instruments will be flown on two near-polar orbiting, Sun-synchronous National Oceanic and Atmospheric Administration operational meteorological satellites for two-year missions to complement the data coverage of the Earth Radiation Budget Satellite mission. The Halogen Occultation Experiments will be flown initially on a seven-day Spacelab 3 mission scheduled for late 1982.

The science activities will be managed by the Langley Research Center and the overall project, including satellite development, will be managed by the NASA Goddard Space Flight Center.

Southern California Land Area Expanding

Measurements carried out independently by research investigators of the U.S. Geological Survey and NASA indicate that Southern California has entered a phase of rapid increase in its area of land surface. Radio noise from distant quasars—powerful celestial objects—helped pinpoint the change.

Dr. A. E. Niell, scientist at NASA's Jet Propulsion Laboratory, Pasadena, Calif., and member of the laboratory's Astronomical Radio Interferometric Earth Surveying Project Team, reported an increase in distance of 20.3 centimeters in seven months between the Pasadena laboratory and the NASA Goldstone Deep Space Station, about 193 kilometers to the northeast.

Niell described the team findings at a session of the fall meeting of the American Geophysical Union in San Francisco. J. C. Savage of the Geological Survey reported, in the same session, results which are consistent with the project team's measurements.

The project team's method of measurements involves recording radio noise from distant quasars simultaneously at the two radio telescope locations. By comparing the time of arriving signals, using extremely precise clocks, changes in distance between the telescopes from one survey to the next can be measured to accuracies of 5 cm or less. The techniques have been developed to the point that such measurements can be used to detect strains over large blocks of the Earth's crust and may have important application to the earthquake prediction mission of the Geological Survey.

Between 1974 and 1978, Geological Survey crews measuring some 250 lines of about 32 km each in length found that all the changes in length recorded were consistent with a uniform north-south contraction of South California. The lines are measured to an accuracy of better than 1 cm using laser beams.

Since 1978, however, the pattern has changed with networks of lines in the Salton Sea and Coachela Valley areas showing extension east-west. At Palmdale, Calif., about 56 km north of Pasadena, the transition from north-south contraction to extensional strain has been more dramatic. Between May and October of this year the land surface has expanded in area by about 2 parts per million. Over an area of about 24 by 32 km the change would amount to the addition of a quarter acre of land to the Palmdale area in six months.

The extension of 20.3 cm over the distance from Pasadena to Goldstone is in approximate agreement with the laser measurements but suggests that the area of expansion may be much larger, perhaps extending over 161 km to the northeast.

There is the appearance from NASA project team data that a similar episode of extension occurred in 1975. However, Geological Survey networks along the San Andreas Fault throughout Southern California showed opposite data, that of compression.

The period over which such precise measurements have been made is less than a decade. From such a short period of data acquisition, scientists are as yet unable to determine whether or not the present pattern is simply one phase of a cycle of compression or expansion.

The suddenness and size of the expansion is intriguing, but as yet, not well understood. There have been other hints in recent years that such large regions of the Earth's crust deform episodically but the six-month period of this large extensional distortion is considered remarkable.

The implications for future earthquakes are speculative and scientists such as Dr. Barry Raleigh of the Geological Survey are prepared only to say that the present pattern of straining, if it persists, is likely to lead to a large earthquake on the San Andreas Fault much sooner than would the earlier pattern of north-south contraction.

Both the Geological Survey and NASA, which sponsor the team project, have increased the frequency of measurements in the area and plan continued close cooperation in these studies.

White House Recognition—Thomas E. Pinelli, second from left, receives a Certificate of Appreciation and Letter of Commendation from Richard M. Harden of the Executive Office of the President, right, for his work in the 1978–79 NASA Career Development Program. Pinelli is from the Langley Research Center, where he is Assistant to the Chief, Scientific and Technical Information Programs Division. Assisting in the presentations were Carl E. Grant, left, Director of Personnel at NASA Headquarters and John Heiss, a personnel officer from the White House.

Advanced Gas Turbine Engine for Autos

A $56 million federal letter contract has been awarded to an automotive industry team headed by AiResearch Manufacturing Company of Arizona, Phoenix, a division of the Garrett Corp., Los Angeles, to develop an advanced gas turbine engine for automobiles as an attractive alternative to the current spark-ignition (internal combustion) engine.

Work performed under this contract represents one of several awards in this phase in a Department of Energy effort with the auto industry to develop the gas turbine as a fuel-saving, multifuel-capable and environmentally safe automobile engine.

The award was negotiated by NASA's Lewis Research Center, Cleveland, which manages several portions of the Department of Energy's highway vehicle systems program including the automotive gas turbine segment. The AiResearch Manufacturing team includes subcontractors Ford Motor Co., Dearborn, Mich.; AiResearch Manufacturing Company of

California and AiResearch Casting Co., both of Los Angeles; and Carborundum Co., Niagara Falls, N.Y. The contract is of the cost-shared, no-fee variety. The AiResearch gas turbine engine concept calls for a single-shaft gas turbine with a continuously variable type of transmission.

The gas turbine has a high potential for fuel efficiency and low pollution. It can run on a variety of petroleum and non-petroleum fuels and could help reduce the nation's dependence on oil.

The advanced turbine system to be developed is expected to use new structural ceramic materials which can withstand high operating temperatures. In the turbine, higher operating temperatures mean greater fuel economy. A large portion of the development effort will be in the area of ceramics.

The specific goal of the AiResearch advanced gas turbine effort, according to Energy and NASA officials, will be to develop and demonstrate by May 1985 an advanced automotive gas turbine powertrain system which when installed in a 1985 production vehicle (a 1,418-kilogram inertia weight vehicle) meets the following objectives:

- Combine cycle fuel economy of 36 miles per gallon based on Environmental Protection Agency test procedures and gasoline fuel;
- Gaseous emissions and particulate levels less than the most stringent federal standards being considered for the 1980s;
- Ability to use a variety of alternate fuels.

The intent is to demonstrate turbine technology in vehicles so that the auto industry can make an early decision on the potential of the gas turbine engine for mass production.

The Energy department's gas turbine program began in 1972 under a contract between the Environmental Protection Agency's clean air program and the Chrysler Corp. It was successively incorporated into the Energy Research and Development Administration and the Energy department under subsequent reorganizations. The total federal investment in the program to date is about $18 million.

Several previous experimental turbine engines have been built and tested in cars under the program including the latest version, a 100-horsepower engine designed and installed in a compact Dodge Aspen body. This program is within Energy's Office of the Assistant Secretary for Conservation and Solar Applications.

Contractor News

Space Systems Group of Rockwell International Corp., of Downey, Calif., has agreed to modify its Shuttle Orbiter contract with the Johnson Space Center to cover integration of payloads and payload carriers. The amendment includes payload flight kit development, payload interface definition, systems studies, payload systems tests and evaluations and other payload interface hardware through December 1983. Value: an estimated $38 million.

General Dynamics Corp., Convair Division, of San Diego, has signed a contract with the Lewis Research Center for management and engineering services to support the Atlas/Centaur launch vehicles program. The cost-plus-award-fee contract of over $12 million will provide for the services in connection with Earth orbital missions during the period December 1, 1979 through December 31, 1980. Centaur, the nation's first high-energy, liquid hydrogen-liquid oxygen rocket vehicle is used as a second stage with the Atlas booster. Management and engineering support activities will be carried out principally at the Convair plant in San Diego and the Eastern Space and Missile Center in Florida.

The National Academy of Sciences in Washington, D.C. has won a $5 million contract modification for continued administration of NASA's Resident Research Associateship Program. The work, to be performed in Washington, calls for the recruitment, evaluation, selection and administration of some 235 additional U.S. and foreign postdoctoral researchers.

The American Institute of Aeronautics and Astronautics (AIAA) has been awarded a $2 million contract extension for continued support of the NASA Scientific and Technical Information Program. Under the terms of the modification, AIAA will continue to acquire significant reports of activities and events related to ongoing and proposed space programs, to analyze the information and publish it in the publication International Aerospace Abstracts.

McDonnell Douglas Astronautics Co., of Huntington Beach, Calif., has received a letter contract from Goddard Space Flight Center for fabrication and subassembly of vehicles for Delta launches 164 and 165. The agreement is an add-on to an existing fixed price contract and amounts to $2 million. The assembly work will be performed at the company's Huntington Beach plant and is to be completed in about 15 months.

Precision Fabricating & Cleaning, Inc., of Sharpes,

Fla., has won a million dollar contract with the Kennedy Space Center extending through December 31, 1980. The firm will fabricate 16 different pneumatic control panels to be installed in the Space Shuttle Mobile Launcher Platform 2. The panels, ranging in size from 3 to 12 feet in length and 5 feet in height, are for the primary distribution and control of high pressure nitrogen and helium gas. The gases are to purge and pressurize the Space Shuttle vehicle and other systems on the platform before propellant loading operations and launch.

Goodyear Aerospace Corp., of Akron, Ohio, has been awarded a $4.7 million contract for fabrication of an ultra high-speed image processing computer called the Massively Parallel Processor. The computer will be installed at the Goddard center and used to extract data from the Earth resources and environment images received there, at present a time-consuming and expensive process. With the Parallel Processor, an image can be handled 10 to 100 times faster than is now possible, at greatly reduced cost. The agreement is a cost-plus-incentive-fee, Phase 2 contract, awarded to Goodyear after the firm's performance of an eight-month Phase 1 design contract on the project.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) and Employer	Title	Patent No.	Installation
Robert E. Frazer, Caltech/JPL	Apparatus for endoscopic examination	4,176,662	NRO/JPL
John M. Franke, LARC	Laser doppler velocity simulator	4,176,950	LARC
Marion L. Roberts Max H. Sharpe Albert C. Krupnick, MSFC	Aluminum or copper substrate panel for selective absorption of solar energy	4,177,325	MSFC
Salvatore R. Riccitiello Paul M. Sawko Carlos A. Estrella, ARC	Catalysts for polyimide foams from aromatic isocyanates and aromatic dianhydrides	4,177,333	ARC
Curt A. Levis, Ohio State University, Columbus, Ohio	Distributed-switch dicke radiometers	4,178,100	GSFC
Terry L. St. Clair Ann K. St. Clair, LARC	Crystalline polyimides	4,180,648	LARC

Launches for 1980

Name	Launch Date	Vehicle	Range	Mission Remarks
FLTSATCOM-C	January 17	Atlas Centaur	ETR	DOD Navy. Reimbursable
SMM-A	February	Delta	ETR	NASA. Scientific Solar Maximum Mission.
Intelsat V-A	September	Atlas Centaur	ETR	Intelsat communications. Reimbursable.
NOAA-B	April	Atlas-F	WTR	NOAA Weather. Reimbursable.
Intelsat V-B	December	Atlas Centaur	ETR	Intelsat communications. Reimbursable.
Navy-20	July	Scout	WTR	DOD Transit. Reimbursable.
GOES-D	August	Delta	ETR	NOAA Weather. Reimbursable.
Navy-21	October	Scout	ETR	DOD Transit. Reimbursable.

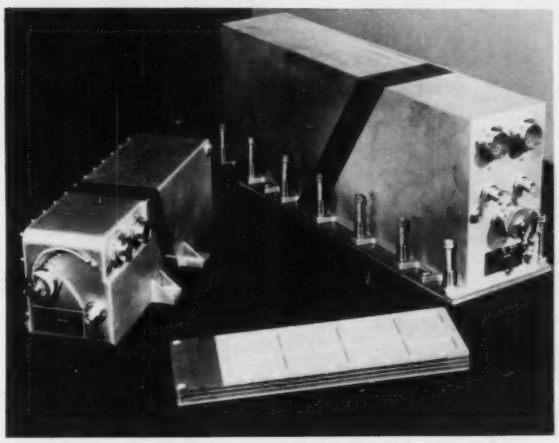
Did You Know?

The Applications Technology Satellite came to the rescue recently when a Pacific atoll was battered by the sea. ATS 1 provided disaster relief communications for the Pacific Trust Territories atoll of Majuro after sea waves swept over the island on November 30 and on December 2. Relief teams flown to the atoll reported 500 homes destroyed or damaged, 4,000 people left homeless and $1.8 million damage to the roads. Our ATS terminal was used to communicate through ATS 1 and the Denver, Colorado, terminal of the Public Satellite Consortium to the Federal Emergency Management Administration office in San Francisco. The terminal was on the atoll as part of a Department of the Interior experiment.

The Kennedy Space Center in establishing a special discretionary fund for pursuing innovative ideas in research and technology has also developed a systematic management approach for administering the program. After receipt of the Resources Authorization (Form 506) the funds are put into the KSC accounting system and identified by a specific code. All activity relating to the code is then closely monitored and the status of the study progress and funding is provided the Center Director monthly. In the event of numerous proposals, an ad hoc panel is convened to assist the Director in his review.

The Madrid Space Station, an integral part of the Deep Space and Spaceflight Tracking and Data networks, has been increasingly active in energy conservation and savings. Because Spain produces only 2 percent of the petroleum it consumes, station personnal began an aggressive energy savings program in 1974 and carried it through to the present. Heating and air conditioning systems have been redesigned, bus service combined, and lighting reduced. Future plans include installation of additional waste heat recovery systems for heating and cooling, replacement of incandescent lights with fluorescent and gas discharge fixtures and correction of the station electrical load power factor. All measures combined have resulted in the overall reduction of fuel at the Madrid Station from FY 1974 through FY 1979 of forty-seven percent, while the actual workload in terms of hours of support increased by thirty percent.

A Workshop to Develop a National College-Level Student Experiment Competition for the Space Shuttle was held at Headquarters in late November. The workshop was organized by the Forum for the Advancement of Students in Science and Technology (FASST) for NASA's Student Activities Steering Committee, chaired by Dr. Glen P. Wilson. Students from professional societies representing 170,000 members heard from Dr. Robert A. Frosch, who called their work, "essential and inherent to the task of the agency", and from former astronaut, Sen. Harrison Schmitt.



Shuttle's Compact Communications—At left is the radio, the size of a carton of cigarettes, that Space Shuttle crewmen will use when working in space outside the Orbiter. A "low profile" antenna for the astronaut unit is in the foreground and at right is a radio assembly that will be installed in the spacecraft. The small radios will provide the communications link between the Shuttle and any space walking astronauts, as well as contact with air traffic control towers and "chase" planes during the landing procedure back on Earth.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

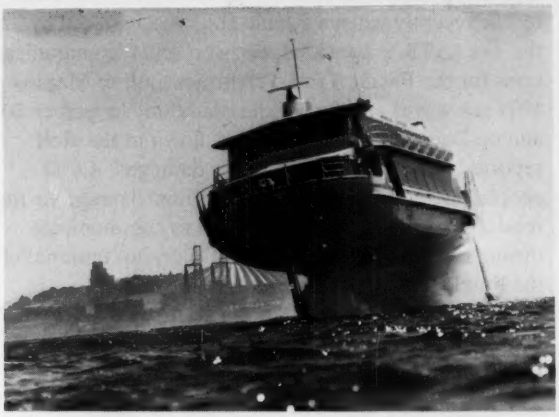
Smooth Passage For The Jetfoil

It is 260 nautical miles across the North Sea from Stavanger on Norway's west coast to Aberdeen in northern Scotland. That's a full day's travel for most conventional ships, a half day for the fastest. In 1977 a hydrofoil named the Flying Princess made a record breaking crossing in just six hours 11 minutes, underlining the speed and convenience that is attracting more and more travelers to hydrofoil transportation.

The Flying Princess is a Boeing Jetfoil,* one of a family of commercial waterjets built by Boeing Marine Systems, a division of The Boeing Company, Seattle, Washington. The new Jetfoil offers a number of advantages over earlier hydrofoils, a major one being a smooth ride in rough waters. NASA technology contributed to jolt-free passenger comfort.

Hydrofoils skim the surface at speeds considerably greater than those of conventional ships because there is little friction between hull and water. Hulls are raised above the water by the lift of the foils, which resemble and function like an airplane wing. The foils are attached to the hull by rigid struts which ordinarily cause a vessel operating in coastal seas to follow the contour of the waves. In wind-whipped waters, this makes for a rough ride. Seeking to increase passenger acceptance, Boeing Marine Systems engineers looked for ways to improve rough-water ride quality.

Langley Research Center conducts continuing ride quality research. Initially, it was later expanded to include all modes of transportation. Research includes studies of vibration, acceleration, temperature, humidity, passenger seats and posture, and the psychological aspects of passenger reaction to vehicle ride. As part of the program, Langley developed instrumentation,



ride quality models and methods of data analysis. The University of Virginia, a Langley contractor, published a report on the subject and Langley held a Ride Quality Symposium.

A member of the Jetfoil development team attended the symposium and followed up by obtaining additional details of Langley's research. The NASA information led to Boeing's design of a computer-controlled system that automatically changes the pitch of the hydrofoils in response to changes in the water movement, eliminating much of the oscillation experienced by hydrofoils moving rapidly through rough water. The result, the company says, is rough-water ride quality unmatched by competitive craft.

The Jetfoil made its operational debut in 1975, operating across the South China Sea from Hong Kong to Macao. In the same year it entered service in the Hawaiian Islands and later, additional services were initiated in Venezuela, Japan and across the English Channel from London to Zeebrugge, Belgium.

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

NASA

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